The Effect of (ALPHA)-Cyclodextrin on the Solubility of Methane into Water for the Formation of Clathrate Hydrates

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Clathrate hydrates, such as methane hydrates, have been known to cause problems in the petroleum industry by forming inside gas transmission lines. This plugs the pipeline, prevents flow, and causes damage, resulting in an expensive fix. It is known that these hydrates form in conditions of low temperature and high pressure. However, hydrates could be understood better. An efficient method of forming hydrates in a laboratory setting would be useful for learning more about them. To form hydrates, water must be supersaturated with gas. The solubility of nonpolar gases, such as methane, is very low. It is hypothesized that cyclodextrin, which are cyclic polymers of the molecule glucose will increase the solubility of methane into water. To test this hypothesis, methane was flowed through a microreactor with water-cyclodextrin solution until stable, segmented flow was established. A gas-water interface was then trapped inside the microreactor for data collection. To collect data, a Raman microscope was used to take spectra of the interface. This was done at various temperatures and pressures, and cyclodextrin concentrations were used from 0 – 5 %wt. The ratio of the areas of the aqueous methane peak to the water peak was calculated for each spectrum. To determine the change in solubility, each ratio was compared to the ratio of the control group, in which no cyclodextrin was present. A calibration curve was also created to find an exact concentration for each ratio of areas. It was found that cyclodextrin did increase the concentration of methane in water.

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